06-18-01

JC09 Rec'd PCT/PTO 15 JUN 2001

PCT

PATENTS

HEROLD AND HAINES
25 Independence Boulevard
Warren, New Jersey 07059-6747
Telephone:908-647-1022

09/868416

Atty's Docket No. 33148.008

EXPRESS MAIL CERTIFICATION

"Express" Mail label number: EK594319426US
(A) Date of Deposit: June 15, 2001

I hereby certify that this transmittal letter and the papers and fees identified in this transmittal letter as being transmitted herewith are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated at (A) above and are addressed to the Assistant Commissioner of Patents, Washington, D.C. 20231

Name of Person mailing the above: Sonya Longo

Sonya Longo
Signature of Person mailing the above item

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (D0/EO/US)

International Application No.: PCT/EP99/10011

International Filing Date: 16 December 1999 (16.12.99)

Priority Date Claimed: 17 December 1998 (17.12.98)

Title of Invention: Method and Reactor for Decontaminating Ground Water

Applicant(s) for DO/EO/US: Holger Weiss and Georg Teutsch

Applicant hereby claims Small Entity Status pursuant to 37 F.R. §1.27

Applicant herewith submits to the United States Designed/Elected Office (DO/EO/US) the following items under 35 U.S.C. 371:

1. ☒ This express request to immediately begin national examination procedures (35 U.S.C. 371(f)).

2. ☒ The U.S. National Fee (35 U.S.C. 371(c)(1) and other fees as follows:

TOTAL CLAIMS 8	- 20 =	CLAIMS OVER 20 0	RATE X $18 =	TOTAL FEES FOR CLAIMS OVER 20 0
NUMBER OF INDEPENDENT CLAIMS 2	- 3 =	CLAIMS OVER 3	RATE X $80 =	TOTAL FEES FOR INDEPENDENT CLAIMS OVER 3 0
MULTIPLE DEPENDENT CLAIM(S) PRESENT No			RATE $270 per APPLN.	FEE MULTIPLE DEPENDENT CLAIM(S)
BASIC NATIONAL FEE (37CFR 1.492(a)(1)-(4)): __ International preliminary Examination fee paid to USPTO (37 CFR 1.482) = $690 __ No International preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2) = $710 __ Neither international preliminary examination fee (37 CFR 1.482) nor International Search fee (37 CFR 1.445(a)(2) paid to USPTO = $1,000 __ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)(2) to (4) = $96.00 x Filing with an EPO or JPO search report = $860				$860
Surcharge of $130 for furnishing the national fee or oath or declaration 20 mos. from the earliest claimed priority date (37 CFR 1.482(e)).				$130
			TOTAL OF ABOVE CALCULATIONS	$990
Reduction by ½ for filing by small entity				
			SUBTOTAL	$495
Process fee of $130 for furnishing the English translation later than 20 mos. from the earliest claimed priority date (37 CFR 1.482(f))				$130
			TOTAL NATIONAL FEE	$625
Fee for recording the enclosed assignment				
			TOTAL FEES ENCLOSED	$625

EK594319426US

a. ☒ A check in the amount of $625 to cover the above fees is enclosed.
b. ☐ Please charge my Deposit Account No. 50-1179 in the amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-1179. A duplicate copy of this sheet is enclosed.

3. A copy of the published International Application as filed (35 U.S.C. 371(c)(2)
a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
b. ☐ is not required, as the application was filed in the United States Receiving Office.
c. ☐ has been transmitted by the International Bureau.

4. ☒ A translation of the International Application into English.

5. Amendments to the claims of the International Application under PCT Article 19
a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
b. ☐ have been transmitted by the International Bureau.

6. ☒ A translation of the amendments to the claims under PCT Article 19

7. ☒ An oath or declaration of the inventor [35 U.S.C. 371(c)(4)]

8. ☐ translation of the Annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Other document(s) or information included:
9. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
10. ☐ An assignment document for recording. Please mail the recorded assignment document to the undersigned.
11. ☒ The above checked items are being transmitted
a. ☐ before the 18th month publication.
b. ☐ after publication and the Article 20 communication but before 20 months from the priority date.
c. ☐ after 20 months (surcharge and/or processing fee included).
Note: Petition to revive (37 CFR 1.137(a) or (b)) is necessary if 35 U.S.C. 371 requirements submitted after 20 months and no proper demand for International Preliminary Examination was made by 19 months from the earliest claimed priority date.
e. ☒ by 30 months and a proper demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
f. ☐ after 30 months (surcharge and/or processing fee included).
Note: Petition to revive (37 CFR 1.137(a) or (b)) is necessary if 35 U.S.C. 371 requirements submitted after 32 months and a proper demand for International Preliminary Examination was made by 19 months from the earliest claimed priority date.

12. At the time of transmittal, the time limit for amending claims under Article 19
a. ☐ has expired and no amendments were made.
b. ☐ has not yet expired.

13. ☐ Certain requirements under 35 U.S.C. 371 were previously submitted by the applicant on _____, namely:

14. ☒ Return postcard.

Please direct all communications in connection with this application to the undersigned at

HEROLD AND HAINES
25 Independence Boulevard
Warren, New Jersey 07059-6747
(908) 647-1022

Brian L. Wamsley

Brian L. Wamsley (33,045)

PCT/EP99/10011

Method and reactor for the decontamination of ground water

Description

The invention concerns a method and a reactor for the decontamination of ground water in accordance with the generic terms 1 and 6.

Numerous methods for the decontamination of ground water are already known up to the present time.

Description of the Related Art

In the DE 44 25 061 C1 a permeable treatment bed is described for the cleansing of contaminated ground water currents in situ as a ditch erected transversely to the ground water current flow, reaching to a point below the ground water bottom fond , and loaded with filling material removing the ground water contaminating substances or converting in the water. Within and along the ditch, a double-wall permeable for the ground water is envisaged which contains the filling material in its intermediate space. As a result of the length of the cleansing route section within the double wall, there is a more or less adequate contacting time of the ground water with the filling material. The ground water is not selectively but, in its entirety and within the structural-technical

measure, is contained, treated and discharged again.

In the DE 42 21 198 C2 a method is described for the removal of water-soluble absorbable pollutants from exiting ground water in the sediments of the surroundings of a contamination source with the help of a narrow wall. In this case, in the way of the exiting ground water a slot is applied which is filled with sorption material. In the way of the exiting ground water, and in the direction of flow downstream of the first slot, a second slot is applied in the sediments and filled with sorption material, as soon as the sorption material in the first slot is loaded up to the level of saturation. This process is continued at random.

In the WO 91/08176 a method is described for the cleansing of ground water contaminated with chlorinated or with halogen-containing organic substances (CKW).

With respect to this, it is proposed that the CKW-contaminated water be channelled for defined holding times through hermetically enclosed metal bodies and that oxygen access be thoroughly avoided in the process. For this purpose it is proposed to excavate a drainage ditch in the water-transporting layer and to locate the metal body in this.

In the DE-A-197 15 038, a description is given for a water-permeable filter wall and a method for making the filter wall to the in-situ ground water cleansing which functions according to the "funnel-and-gate" principle.

The use of the filter wall is bound to certain prerequisites, allowing in particular no consideration of the vertical pollutant distribution and, relevant hereto, the minimization of the water quantities to be cleansed. The use in greater depths is not established. The measure involved here is purely passive.

Furthermore, the problem of cleansing contaminated ground water is also dealt with in the documents US 5,534,154, US 5,487,622 and US 5,362,394.

With all methods known up to the present time, the entire construction-technical contained aquifer areas are treated and again discharged on a broad front. The horizontal current flow calls for a construction width which allows the residence time as required for the degradation of pollutants. Gate, slot or ditch widths are required in sizes of ten meters and more, and these result in high costs.

The invention is therefore based on the task assignment of developing a method and a reactor of the category mentioned at the introduction to this document, with which a cost-favorable and selective ground water extraction from random horizons are ensured for selective and reliable treatment (decontamination).

In accordance with the invention, this task assignment is solved by the features of the Claims 1 and 3. According to the invention, the contaminated ground water is directed into a reactor at a random height below the ground water level, and conducted through a reaction chamber with at least one reaction agent in dependence of the required residence duration period,

and directed as cleansed ground water at a required height from the reactor, where the height of the input of the ground water into the reactor is selected in accordance with the pollutant type and the pollutant location in the ground water.

For decontamination, the contaminated water flows vertically through a drop shaft designed as a reactor and containing the reactive material.

The reactor according to the invention is located, according to the known drop shaft technology, into a point in the bottom fond of the horizon which conducts the contaminated water.

The reactor has a reaction chamber with at least one feed line and at least one outlet line (gravel casing well, outlet flow wake). The reaction chamber contains at least one reaction agent and reaches up to the reactor base and is closed off below the ground water level.

The coupling of the drop shaft technology with known methods of redevelopment technology provides for hydraulic advantages such as the possibility of the selective ground water extraction from almost random horizons in the required scope. This option is a major advantage for a series of cases of damage. It is frequently the case that contaminations are not evenly distributed in the ground water but are concentrated in certain horizons. For this reason and for decontamination purposes, only this part of the ground

water must be extracted and treated. In addition, the treated ground water can be discharged in random depth zones of the aquifer.

In order to cover the scope of pollutants which are heavier than water, and in accordance with an embodiment of the invention, the ground water is conducted to the reactor in the lower zone and discharged as cleansed ground water below the ground water level from the upper zone of the reactor.

In order to cover the scope of pollutants which are lighter than water, oil for example, and in accordance with an embodiment variant of the invention, the ground water is conducted to the reactor in the upper zone below the ground water level and also discharged again after the contaminated ground water, for the purpose of achieving a longer residence duration period in the reactor, was first directed downwards and then upwards along an intermediate wall which is open in the lower zone of the reactor.

In order to cover the scope of pollutants which are in the middle area of the ground water column, for example suspended substances or pollutants in the island areas made from clay/loam for example, and in accordance with a further embodiment of the invention, the ground water is conducted to the reactor in the middle zone and directed along an intermediate wall in a downward direction and, from there, along an intermediate wall into the upper zone of the reactor and withdrawn below the ground water level.

With the previously known "funnel-and-gate"-slot or ditch technology, the entire construction-technical contained aquifer areas are, by contrast, treated and discharged again on a broad front. With the known methods, the horizontal flow current demands a structural width which makes possible the necessary residence time required for pollutant degradation. As the current flow velocity must always be greater than the natural ground water flow velocity and, in the case of complex pollutant mixtures or with substances difficult to metabolize, degradation times of more than ten days are required, gate-, slot- or ditch widths of ten meters and more are required and this leads to an extraordinary cost increase of the construction. The same applies for the depth of the necessary structures. Structures previously realized according to the known methods reach only a few meters in depth. By means of the method according to the invention, vertical flow current lengths (residence times) up to the difference well depth - pressure water level can be realized and pumping would not be necessary in this case. The coverage of larger ground water currents can be achieved by the connection of several wells through non-permeable walls.

Advantageous further developments of the invention result from the subclaims.

Brief Description of the Drawings

The features of the invention will be better understood from the following description of a most preferred embodiment of a reactor. The drawings illustrate the following:

Fig. 1 a schematic illustration of the reactor according to the invention in working position for pollutants heavier than water,

Fig. 2 a schematic illustration of the reactor according to Fig. 1 for pollutants lighter than water and

Fig. 3 a schematic illustration of the reactor according to Fig. 1 for pollutants in the middle region

For the decontamination of contaminated ground water 5 (pollutant wake) in various layers, and based on the method according to the invention, the contaminated water is routed immediately from the contaminated water layer 5 by way of feed lines (horizontal drainage), for example gravel casing well 3, into a drop shaft 1 where the reactive material 2 is located, and where the drop shaft 1 has a vertical current flow. The drop shaft 1 is positioned in the non-permeable horizon 1 in such a way that its location in the ground water direction of flow 7 is upstream of the pollutant wake 5.

The Fig. 1 shows in a schematic arrangement the design in principle of a reactor for executing the method according to the invention, consisting of the drop shaft 1 and the reactive material 2 contained therein, for pollutants which are heavier than water and which are subsequently located in the lower part of the aquifer.

The drop shaft 1 of the reactor is, for example, formed from concrete segments with a height of 2.5 m and an internal diameter of 3 m and a shaft depth of 20 m, with its foundation up and into the non-permeable horizon 6. The drop shaft 1 is filled with reactive materials 2 such as Fe^{0} and indicates in the lower region, in the immediate target horizon, gravel casing wells 3 which, for example, are projecting 10 m long into the aquifer. By way of this water capacitance in the lower region of the ground water-carrying layer 8, the contaminated ground water 5, based on the hydraulic properties and without pumping, is conducted into the shaft 1 which is filled with reaction materials 2. The ground water fed in for decontamination flows vertically (arrow direction) through the reaction material 2 (according to dimensioning) and is then infiltrated in the upper region of the water-carrying layer 8, meaning, it is drawn off below the ground water level 9 (outlet flow wake 4).

The Fig. 2 shows in a schematic arrangement the configuration of the reactor for a situation where the pollutants are lighter than water and, subsequently, are directed into the reactor in the upper region of the water-carrying layer 8 by way of horizontal gravel casing wells 3.

The contaminated water 5 is directed at first through the reactive material 2 in the drop shaft 1, possibly by means of a non-illustrated pump, vertically and in a downward direction at an open intermediate wall 10 in the bottom zone of the drop shaft 1, and then diverted upwardly, and then conducted out below the ground water level 9 (outlet flow wake 4).

The Fig. 3 shows in schematic arrangement the configuration of the reactor consisting of the drop shaft 1 with the reactive material 2 for the case that the pollutants are located in the middle region of the water-carrying layer 8.

From the drop shaft 1, the horizontal gravel casing wells 3 are driven immediately into the target horizon with the contaminated water 5, the contaminated water 5 is led into the drop shaft 1 and, as in example 2, routed through the reactive material 2 of the drop shaft 1 and conducted out below the ground water level 9 (outlet flow wake 4).

The use of pumps is only then necessary in exceptional cases if the self-pressure is inadequate particularly where unconfined aquifers are concerned.

The invention is not limited to the embodiments described in this document. Moreover, it is possible to realize further embodiment variants by means of combination and modification of the features described above, without departing from the framework of the invention.

Method and reactor for the decontamination of ground water

Patent Claims

1. Method for the decontamination of ground water with the use of vertical shaft technology from the wells drilling technique, the manufacture of horizontal filter wells and of reaction agents, where the contaminated ground water (5) in a random height below the ground water level (9) is led into a reactor (1, 2) and conducted through a reaction chamber (1) with at least one reaction agent (2) in dependence on the required residence duration period and is discharged as cleansed ground water (4) in a required height out of the reactor (1,2), where the height of the ground water inlet into the reactor (1,2) is selected depending on the type of pollutant and the location of the pollutant in the ground water (8).

2. Method according to Claim 1, wherein the reactor (1,2) is located vertically into the bottom fond of the horizon carrying the contaminated ground water (5) where, in the zone of the reactor (1,2) envisaged for the ground water inlet, at least one perforated feed line (3) is led out horizontally into the ground water (8) by way of which the contaminated ground water (5) flows into the

reactor (1) filled with reaction agent (2).

3. Method according to Claim 1,wherein
for the inclusion of pollutants which are heavier than water, the ground water is conducted to the reactor (1,2) in the lower region and is discharged below the ground water level (9) from the upper region of the reactor (1,2) as cleansed ground water (4).

4. Method according Claim 1, wherein,
for the coverage of pollutants which are lighter than water, the ground water is conducted to the reactor (1,2) in the upper region below the ground water level (9) and also discharged again after the contaminated water (5), for the purpose of achieving a longer residence duration period in the reactor (1,2), was first directed downwards and then upwards along an intermediate wall (10) which is open in the lower region of the reactor (1,2).

5. Method according to Claim 1, wherein,
for the coverage of pollutants which are in the middle region of the ground water carrying layer (8), the ground water is conducted to the reactor (1,2) in the middle region and directed along an intermediate wall (10) in a downward direction, and there along an intermediate wall into the upper region of the reactor (1,2) and withdrawn below the ground water level (9).

6. Reactor for the decontamination of ground water in the type of a well manufactured in drop shaft

technology, where a reaction chamber (1) is envisaged for accommodating at least one reaction agent (2) and with at least one feed line and at least one outlet line (3,4) in a desirable height, however below the ground water level (9), reaching to the reactor base and is closed off below the ground water level (9).

7. Reactor according to Claim 6, wherein in the reactor (1,2) at least one intermediate wall (10) is included which is open in the upward or in the downward direction.

8. Reactor according to Claim 6, wherein several reactors (1,2) are connected up together.

Reference Numbers List

1	Drop shaft
2	Reactive material
3	Gravel casing well (feed line, horizontal drainage)
4	Outlet flow wake (discharge)
5	Pollutant flow wake (contaminated water)
6	Non-permeable horizon
7	Ground water - direction of flow
8	Ground water carrying layer
9	Ground water level
10	Intermediate wall

Summary of the Invention

The invention concerns a method and a reactor for the decontamination of ground water with the use of the vertical shaft technology from the well drilling technique, of the manufacture of horizontal filter wells and of reaction agents.

The task assignment of the invention, to develop a method and a reactor of the type described in the beginning of this document, with which a cost-favorable and selective ground water extraction from random horizons for the selective and reliable treatment (decontamination) are ensured, is solved in such a way that the contaminated ground water (5) in a random height below the ground water level (9) is directed into a reactor (1,2) and conducted through a reaction chamber (1) with at least one reaction agent (2) in dependence on the desired residence duration period and is discharged as cleansed ground water (4) in a desired height from the reactor (1,2) where the height of the ground water inlet into the reactor (1,2) is selected depending on the type of the pollutant and the location of the pollutant in the ground water (8). - Fig. 1 -.

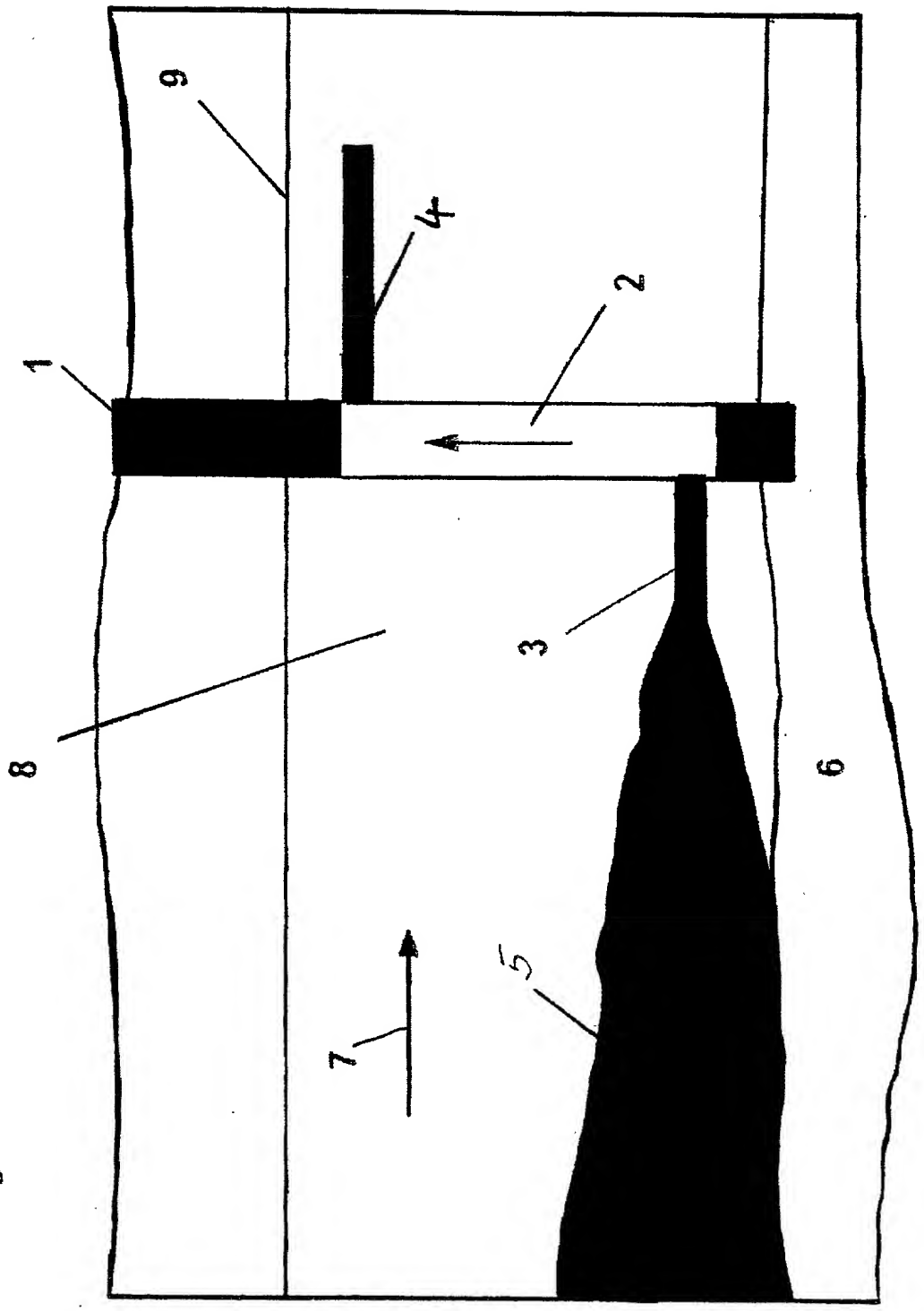

Fig. 1

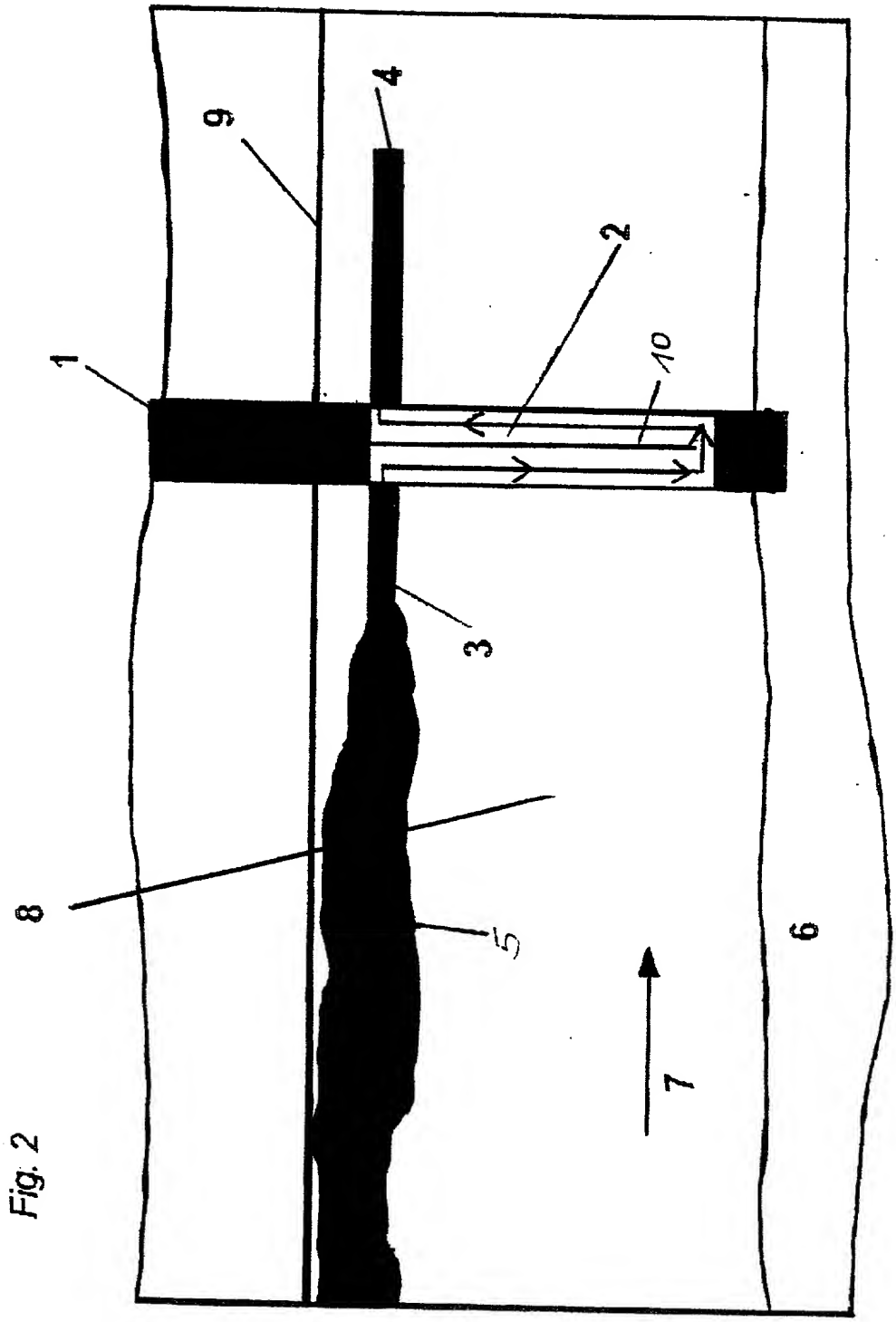

Fig. 2

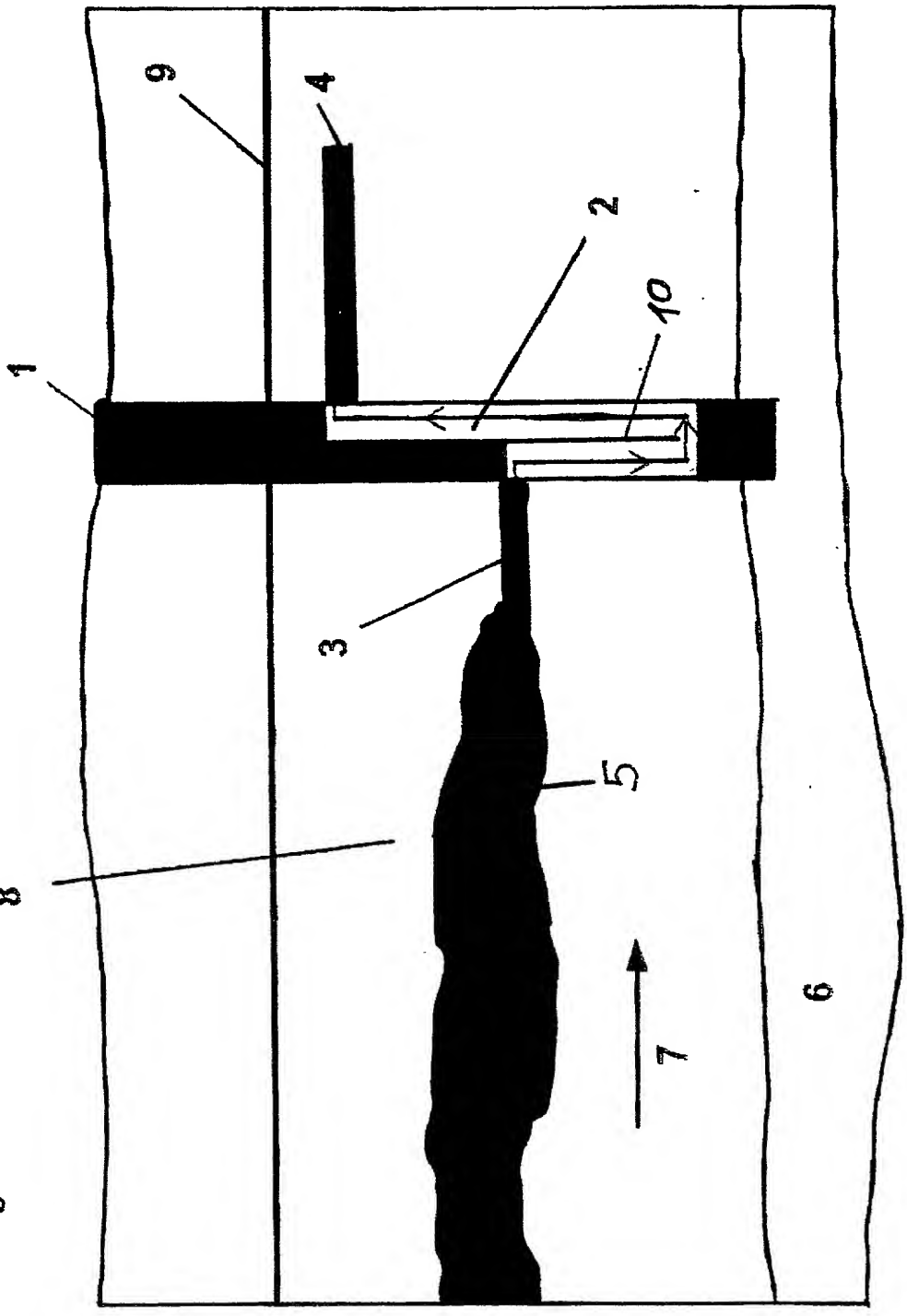

Fig. 3

Goodwin Procter, LLP
599 Lexington Avenue
New York, New York 10022
United States of America

If each inventor understands English, the Declaration and Power of Attorney below is suitable for use when filing a regular patent application and also when entering the national stage, in the case of an International application designating the USA under the PCT.

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	Attorney Docket no 103701/134136

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name,
I believe I am the original, first and sole inventor (if only one name is listed below at 201) or an original, first and joint inventor (if plural names are listed below at 201-205) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Method and Reactor for Decontaminating Ground Water

the specification of which (check one)

___ is attached hereto

_x__ was filed on _December 16, 1999___

under Serial Number __PCT/EP99/10011____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I list below any prior foreign application(s) for patent or inventor's certificate in respect of which foreign priority benefits are claimed under 35 USC 119; and any prior foreign application(s) for patent or inventor's certificate in respect of which such foreign priority rights are not claimed and which has a filing date before that of any application in respect of which such foreign priority benefits are claimed:

Application Number	Country	Filing Date (day, month, year)	Priority Claimed under 35 USC 119
198 60 129.8	**GERMANY (DE)**	**17.12.98**	YES: _x_ NO: ____
			YES: ____ NO: ____
			YES: ____ NO: ____

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

Application No.	Filing Date

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

X Signature of Inventor 201 Weiß	X Date 25-05-01
X Signature of Inventor 202 Teubach	X Date 25-06-01
Signature of Inventor 203	Date
Signature of Inventor 204	Date
Signature of Inventor 205	Date

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Brian L. Wamsley (33,045)

201 1 - 00	Family Name WEISS	First Given Name Holger	Second Given Name
	City of Residence Panitzsch DEX	State or Foreign Country Germany	Country of Citizenship Germany
	Post Office Address Gerichtshainer Str. 8D	City 04451 Panitzsch	State & ZIP/Country Germany 04451
202 2 - 00	Family Name TEUTSCH	First Given Name Georg	Second Given Name
	City of Residence Wannweil DEX	State or Foreign Country Germany	Country of Citizenship Germany
	Post Office Address Silcherweg 30	City 72827 Wannweil	State & ZIP/Country Germany 72827
203	Family Name	First Given Name	Second Given Name
	City of Residence	State or Foreign Country	Country of Citizenship
	Post Office Address	City	State & ZIP/Country
204	Family Name	First Given Name	Second Given Name
	City of Residence	State or Foreign Country	Country of Citizenship
	Post Office Address	City	State & ZIP/Country
205	Family Name	First Given Name	Second Given Name
	City of Residence	State or Foreign Country	Country of Citizenship
	Post Office Address	City	State & ZIP/Country

United States Patent & Trademark Office

Office of Initial Patent Examination -- Scanning Division

Application deficiencies found during scanning:

☐ Page(s)___________ of __________________________________ were not present for scanning.
(Document title)

☐ Page(s)___________ of __________________________________ were not present for scanning.
(Document title)

☑ ***Scanned copy is best available.*** Drawings are too dark